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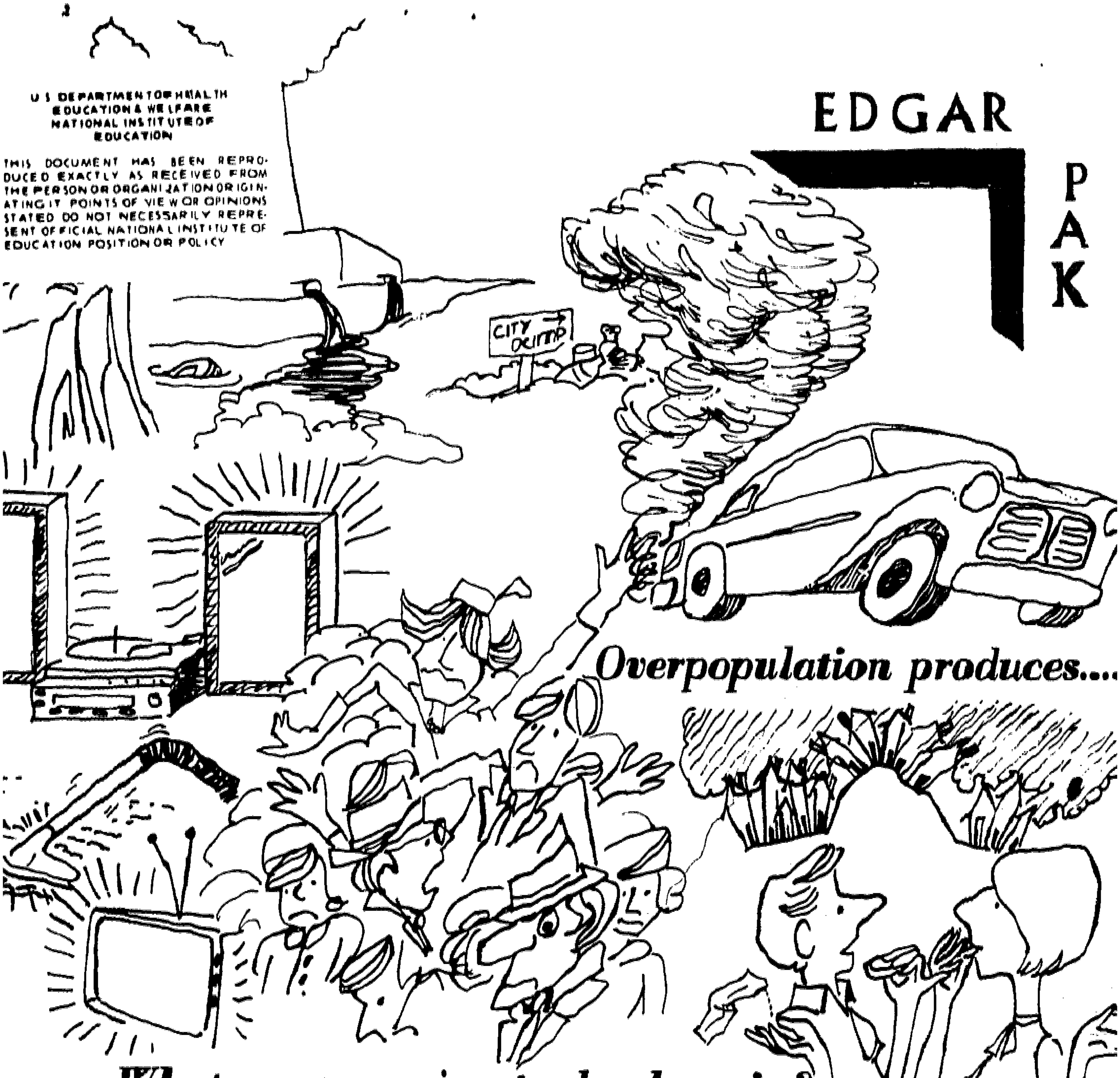
ABSTRACT

This unit is one of a series produced for environmental education programs by the Highline Public Schools. These materials are designed for use with junior high school students studying the concept of population, population trends, and problems created by changes in populations. The seven concepts in the unit take about three weeks to complete. The materials are most easily adapted to science or geography classes. Each lesson includes the concept of the lesson, materials needed, probable time for the lesson, procedure, evaluative activity, and suggested extra activities. Materials for making ditto masters are included. (RH)

EDGAR PAK



Overpopulation produces....

What are we going to do about it?

by Linda Edgar

An Environmental Learning Experience for Jr. High Science. One of many "ELE Paks" available for all areas.

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CONCEPTS

1. The world population is increasing.
2. Increased population may cause starvation and increase in resource demands.
3. Increased population is causing people to be faced with living in areas of increased density.
4. The need for food has encouraged the use of more pesticides for agricultural use. Problems result when man alters his environment for greater production.
5. Overpopulation causes increase in air, water, waste and noise pollution.
6. All organisms must adapt to changes in their environment if they are to survive.
7. Man is an organism that must adapt to the changes that are occuring in his environment or attempt to control these changes to improve his environment.

RATIONALE

Population increase and its effects on the environment present a problem that this generation and all future generations will have to cope with. There is little reason to believe that population growth will cause food shortages in the United States, but serious questions have been raised about the effects of continued population growth on our world's resources and on the pollution of our land, air and water.

Even though population growth is not the primary cause of environmental deterioration, it may well magnify the problems arising from the way we use our resources and technology.

The 7 concepts in this unit are designed for use in either a junior high science or geography class. The approximate time required for each lesson is given and the whole unit should take between 2 to 3 weeks to cover. Several extra activities, supplementary films, and experiments have been added to extend each lesson. These extra activities usually tend toward either the science emphasis or geography (anthropology) emphasis and can be interchanged with the material in the lessons. All of the films may be found at the Highline Educational Resource Center.

A master materials list by lesson is given on the next page. Most of the materials will be found in the KIT accompanying the ELE. Three quizzes with answer sheets have also been prepared on separate sheets which can be easily copied and dittoed for your convenience. The information sheets provided for use by the students are also on separate sheets which can be copied and dittoed.

A pre and post test has also been made available for evaluation of the students and the ELE.

MASTER MATERIALS LIST

Lesson 1 - Ditto #1, 2, 3
Overhead transparency of Ditto #1
Film: Populations, 16 min. color

Lesson 2 - Chalk
Ditto #3, 3a, 3b
Film: Changing City, 17 min., color

Lesson 3 - Quiz #1 ditto
Ditto # 4, 5, 6, 7
Overhead transparency of Ditto #4, 5
Film: City Limits, 28 min., color
Geography of the U. S. Pacific States, 17 min. color

Lesson 4 - Ditto 8
Quiz #2
Film: Of Broccoli, and Pelicans, and Celery, and Seals, 30 min., color

Lesson 5 - The litter fact book
Ditto 9, 10, 11, 12, 13, 14, 15, 16
Films: Recycling Wastes, 12 min., color
Noise is Pollution Too, 15 min., color
Air is For Breathing, 28 min., color
Conserving our Environment, 14 min., color
Slides: Man and His Effects on the Environment (40 min. + tape)
Ditto 13
Nylon stocking, stiff cardboard (1' x 1')
wood pole 3 feet long
magnifying glass
Ditto 14
2 quart plastic container
2 cups of pebbles
coarse sand
gravel — any construction company should supply these free
fine sand
2 feet of wood 8" wide
nails (4)
Ditto 15
newspaper, mixing bowl, egg beater, tablespoon of wall paper paste, starch or flour, section of a window screen, wax paper, drinking glass
Ditto 16
wood base, 6" x 6"
wood support 14" long
cardboard tubing 1½" in diameter (paper towel roll)
aluminum foil 6"x6"
2 toothpicks, 6 volt lantern battery, 9 feet of bell or hook up wire
knife switch
Type F-7996 induction coil of Model T spark coil

For your convenience the films used in this ELE are listed on this tear out sheet. Simply add the dates required and mail to the Instructional Material Center, ERAC.

Project ECOLogy

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INSTRUCTIONAL MATERIALS - HIGHLINE PUBLIC SCHOOLS

Symbols for materials not booked:
NA = not available
Sub = substitution
WD = withdrawn

ORIGINAL

Please try to place orders 3 weeks in ADVANCE in DUPLICATE

SCHOOL ________ TEACHER ________ GRADE ________ DATE ________

FILMSTRIP NO.	FILMSTRIPS - TITLE	DATE WANTED	NOT WANTED AFTER	DATE CONFIRMED	FILMS	DATE WANTED	NOT WANTED AFTER	DATE CONFIRMED
					Populations			
					Changing City			
					City Limits			
					Of Broccoli & Pelicans & Celery & Seals			
					Geography of the U.S. Pacific States			
	SLIDES				Noise is Pollution Too			
	Man and His Effects on the Environment				Air is for Breathing			
					Conserving our Environment			
					Recycling Wastes			
					Search to Survive			
					Ice People			
					The Winners			
					Ecology (Animal Secrets)			
					Desert Insects			

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SLIDES				~~Noise is Pollution Too~~			
Man and His Effects on the Environment				Air is for Breathing			
				Conserving our Environment			
				Recycling Wastes			
				Search to Survive			
				Ice People			
				The Winners			
				Ecology (Animal Secrets)			
				Desert Insects			

LESSON 1

CONCEPT: The world population is increasing.

MATERIALS: Ditto and overhead transparency of "How Many People"
Dittoes #1, #2, #2a
Film: Populations, 16 min., color

TIME: 50 min. (with film)

PROCEDURE: Ask: *How many students plus sisters and brothers do we have in this class?* (90 children might be an approximate number. Put this on the board.)

State: *You and your brothers and sisters get married to other people and each have 3 children after 20 years.* Ask: *How many people would be in the population of the next generation?* (3 x 90 = 270 people - put on board.)

How many children could each of you have to keep the population the same? (one - 1 x 90) *If you were to marry someone how many children could you have to keep the population from growing?* (2, or each person can replace himself)

Show overhead transparency of "How Many People" (Ditto #1). Ask: *What historical changes do you think lead to the increasing rate of population growth.* (food supply, space, resources) *Do you think the population curve will change again?* (yes - the students may have different reasons) *How many years will it take before there is one person per square yard of the earth's surface?* (57,864,610 sq. miles x 1760 yds/mile) (3½ billion people now - see evaluative activity)

If you think this population curve might change, what do you think will cause the change? (lack of resources, space, food, water)

Some or all students may wish to do the activity on ditto #3 to see what limits population growth.

Film: Populations, 16 min., color - effects of overcrowding

EVALUATIVE ACTIVITY: Ask: *If every family had 4 children every 25 years how long would it take for there to be only 1 square yard per person in the world?* (126 years)

Answer: There are 3½ billion people now.

3,500,000,000/96,140,713,600 sq. yards

1975	3.5 billion 2	(4 children per family or 2 children per person)
2000	7.0 2	
2025	14.0 2	
2050	28.0 2	
2075	56.0 2	
3000	112.0	

DITTO NUMBER 1 HAS BEEN REMOVED PRIOR
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CAN MAN DECIDE ON HIS POPULATION GROWTH?

In one way or another, the growth of a population of any species eventually comes to a halt. The organisms may run out of food, they may be poisoned by their own wastes; their reproductive behaviour may go awry - many things may happen, but as you have observed in your experiments, every population ever observed at some time ceases to grow. The only question is, will it then remain stable, decline gradually, or fall catastrophically?

Many people believe that, because man is an animal uniquely able to reason about the future and adapt his society to changing conditions, he should be able to manage the human population growth curve so that it does not end in a catastrophic decline.

In what ways would it be possible for people consciously to regulate the size of the human population? Does your country or community now have any laws that either encourage or discourage population growth? What are they?

If you were going to plan a program of laws and other measures to maintain a stable population in your community, what measures would you take?

SOURCE: BFA Educational Media

DOES A POPULATION GROW INDEFINITELY?

Choose a species of organism, plant or animal, and grow a population of it. Some suitable organisms would be:

yeast (grow in molasses and water)

paramecium (grow in water with some pepper corns)

didinium (grow in water with some pepper corns and paramecia)

hydro (grow in pond water)

meal worms (grow in bran)

Plan a way to estimate the number of individuals each day. How does the number change? Does the population go on increasing forever? What might limit the growth of populations of living things? How would you find out what the limiting factors are?

SOURCE: BFA Educational Media

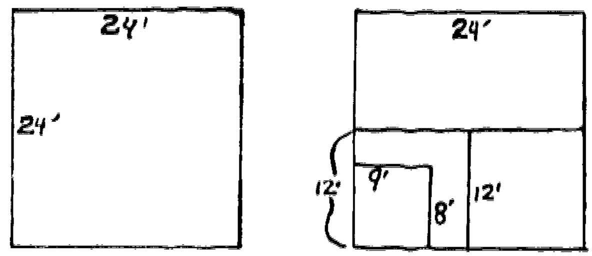
LESSON 2

CONCEPT: People are being faced with living in increased density areas.

MATERIALS: Chalk
Dittoes #3, 3a, 3b
Film: Changing City, 17 min., color

TIME: Approximately 50-65 min., with film

PROCEDURE: Mark off 2 24x24 foot square areas. Divide one square in half - 12x24 and then make an 8x9 foot area. (see diagram below)



Place 1 group of 8 people in the 24x24' square.

Place the other group in the 12x12' square. Have the rest of the class be conspicuous observers of the reaction of both groups.

Hand out the dittoed exercise "Can You Stand Inside a Square" to everyone including the observers. Have them complete these. (20 minutes)

After about 10 minutes ask the group to move into the 8x9' area - they should remain there to finish their assignments.

When the assignments are finished ask the observers to come forward and reveal their observations of both groups.

Discuss any evidence of the crowded group leaving the squares more often than the other group.

Film: Changing City, 17 min., color

EVALUATIVE ACTIVITY: Oral: *What is one problem caused by overpopulation? What effects might this cause?*

SUGGESTED EXTRA ACTIVITIES: Obtain 2 groups of rats (same sex). Place 2 in one cage and 10 in a cage of the same size. Make any observations you can.

You may do the above with any kind of animal.

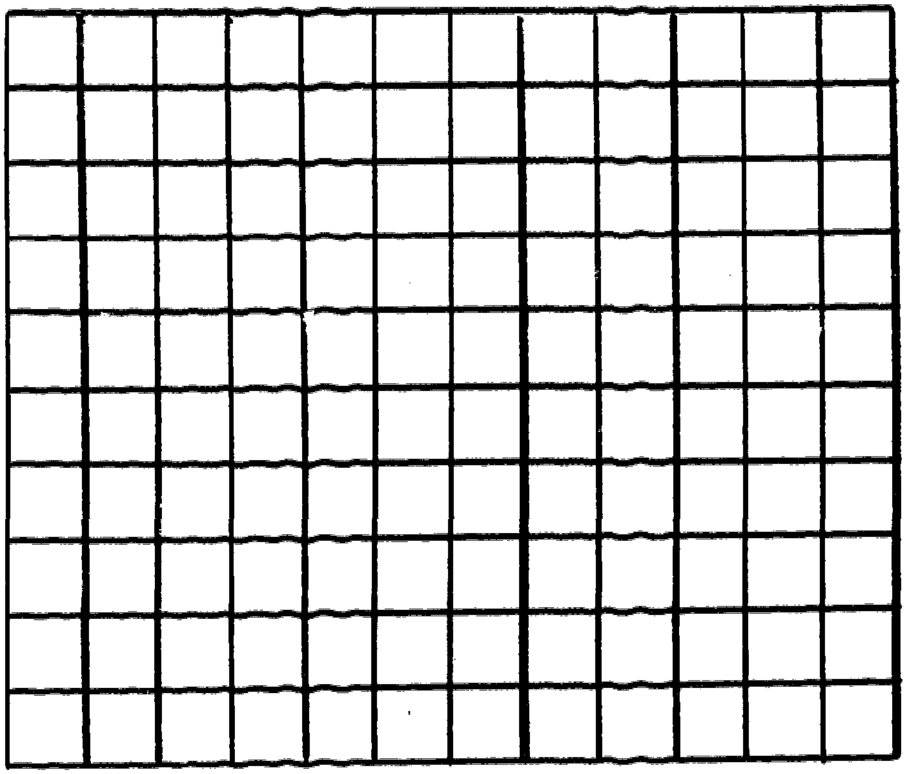
Ditto 3a - How Population Density Affects Plant Growth.

Ditto 3b - How Many People do you Meet in a Day?

DITTO #3

CAN YOU STAND INSIDE A SQUARE?

Imagine that your classroom is 10 meters by 12 meters. A diagram of this classroom is shown below. The classroom has been divided into 1-meter squares.



1. How many squares are in the diagram? ____________________

2. What is the student population of your classroom? ____________________

Pretend that each student has a space of 1 square yard. For each student, draw an "X" in 1 square. The number of "X's" should equal the number of students.

Imagine that the student population doubles in 1 year.

3. How many students would there be in 1 year? ____________________

4. How many more "X's" would you have to draw to equal the population? __________

Draw the additional "X's" needed to equal the population.

Imagine that the student population doubles again in 1 year.

5. How many students would there be in 2 years? ____________________

6. How many more X's would you have to draw to equal the population? __________

Draw the additional X's needed to equal the new population.

Imagine that the student population doubles again in 1 year.

7. How many students would there be in 3 years? ____________________

8. How many more X's would you have to draw to equal the population? ____________

Draw the additional "X's" needed to equal the population. You must use up all the X's.

9. If you run out of squares, what will you have to do with the extra X's? ________

____

10. What is a population? ____

____

11. What is overpopulation? ____

____

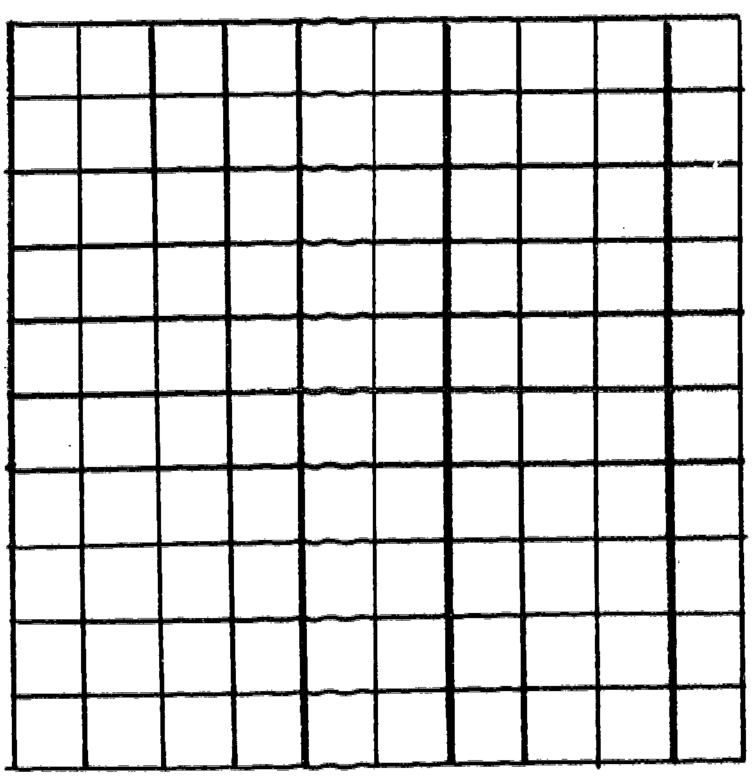
Look at the clock and count the seconds. Do you know how long it would take you to count 1 billion seconds? 30 years. Yes, 30 years!

12. How long would it take to count 8 billion seconds? ____________________

The world population is expected to be 8 billion by 2010. But if you started counting now, you couldn't even count that many people! And the world's population is expected to double again 35 years later!

Today, 70 percent of the world's population lives on less than 4 percent of the land. Do you know how crowded that is?

There are 100 squares in the diagram below. Draw 70 X's in 4 of the squares. Then spread out 30 X's in the other squares.



13. What is a population? ______________________________

____

14. What is overpopulation? ______________________________

____

DITTO #3a

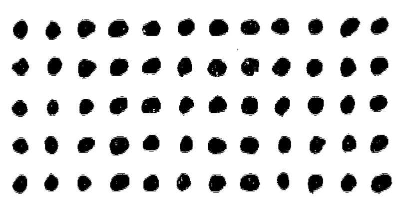
HOW DOES POPULATION DENSITY AFFECT PLANT GROWTH?

Prepare three flats for planting by adding the same kind of soil to each flat. Mark off the flats in squares. In one flat make the squares 3 cm on a side, in another 7 cm on each side, and in the third 15 cm on a side. Plant a sunflower seed in the middle of each square, making a pattern like that shown below. (Grow some additional seedlings in a fourth flat to replace seeds that don't germinate in other flats.) Let the plants grow, treating the flats exactly the same.

At the end of five weeks cut off all the plants at the soil line. Discard all the plants from the outside rows next to the edges of the flat. Dry the remaining plants in an oven, then weigh the plant material produced by each flat. Calculate the average weight of a plant at each density, and also the number of grams of plant material produced per square meter at each density. Graph your results. Can you say what population density of sunflowers will produce the greatest amount of plant materials for the area available?

What might account for the differences on growth? Would a different density have produced the most plant material if, for example, you had given the flats more or less water?...fertilizer?

Test your ideas by further experiments, perhaps with other species.



SOURCE: BFA Educational Media

DITTO #3b

HOW MANY PEOPLE DO YOU MEET IN A DAY?

Many social scientists believe that an important psychological stress on modern city dwellers is the number of strangers with whom they come in contact every day.

For one day, keep a record of every person with whom you come in contact. (For the purpose of this experiment, by "coming in contact" we will mean being close enough to the person to recognize him if you knew him.) One way of keeping the record is to mark an X on a sheet of paper each time you see a person you don't know, and an O every time you meet a person you do know.

In an average day, do you see more people you know or you don't know? It's interesting to compare your record with records kept by other students.

SOURCE: BFA Educational Media

LESSON 3

CONCEPT: Increased population may cause starvation and increase in resource demands.

MATERIALS: Dittoes #4, 5, 6, 7
Films: City Limits, 20 min., color, ACI-1972
Geography of the U.S. Pacific States, 17 min., color
Quiz #1

TIME: 50-65 minutes (with film)

PROCEDURE: If your class meets around noon, ask them to bring their lunches to class.

State: *We are representing the world food supply. Now let's suppose the population has doubled but we don't have any increase in food production.*

Ask: *How many of you will have to go without your lunch?* (50%)

Show overhead of ditto #4 - point out the increase in population in Washington State.

Ask: *How fast is Washington's population increasing?* (doubling every 30 years) *Is our food production increasing as fast?* (no)

Show overhead of ditto #5 - Limits to Growth.
Point out what static index means. (the number of years the resource will last if the population does not increase). Exponential Index is the number of years the resource will last if the population continues to increase at it's present rate.

Review: *So far we have discovered that more people means (1) less food and (2) fewer resources.*

Ask: *What other problems does an increase in population create?* (See ditto #6) Try and get the kids to come up with these ramifications.

Show film: City Limits (28 min.)

EVALUATIVE ACTIVITY: Quiz #1

SUGGESTED EXTRA ACTIVITIES: Why did the deer die off? (Ditto #7)

ANSWERS TO QUIZ #1:

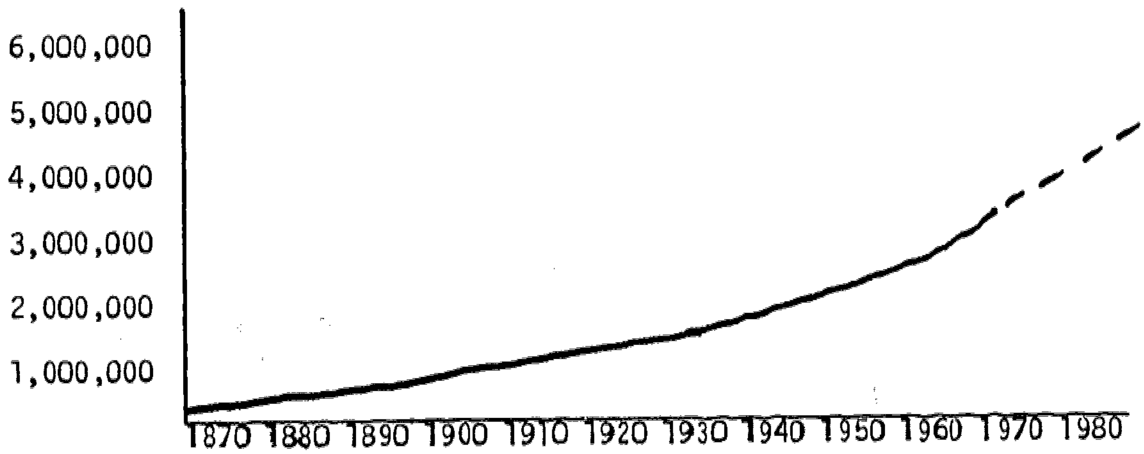
1. F
2. F
3. T
4. F
5. F
6. 2

7-10. Any of those items on Ditto #6

DITTO #4

CONSEQUENCES OF WASHINGTON'S POPULATION

In 1870, the area which is now the State of Washington, had a population of about 24,000. In 1890, just after Washington became a state, its population was about 360,000 -- about 15 times greater. In 1930, our state's population was 1,560,000. By 1968 it had grown to 3,290,000.



Much of the state's early population increase was due to immigration, which is still an important factor. In the last decade, about 45% of Washington's population growth resulted from immigration. Natural increase (the excess of births over deaths) accounted for the other 55%.

Between 1870 and 1894, the population of Washington was doubling on the average of once every 6 years. At present our population seems to be doubling approximately every 30 years - much faster than the rest of the country. Our present rate of population growth is about 2.3% each year.

The population of Washington is very unevenly distributed. In 1968, about 2,400,000 people lived in Western Washington and about 89,000 lived in Eastern Washington.

POPULATION DENSITY (People per square mile)

	Entire State	Western Wash.	Eastern Wash.
1900	7.8	16.0	4.0
1960	42.8	82.2	19.4
1968	49.4	97.2	21.0

DITTO #5

NONRENEWABLE NATURAL RESOURCES

RESOURCE	STATIC INDEX	EXPONENTIAL INDEX
Aluminum	100	31
Chromium	420	95
Coal	2300	111
Cobalt	110	60
Copper	36	21
Gold	11	9
Iron	240	93
Lead	26	21
Manganese	97	46
Mercury	13	13
Molybdenum	79	34
Natural Gas	38	22
Nickel	150	53
Petroleum	31	20
Platinum	130	47
Silver	16	13
Tin	17	15
Tungsten	40	28
Zinc	23	18

SOURCE: Limits to Growth by Meadows, Meadows, Randers, Behrens III

DITTO #6

More People Means.....

1. Starvation

   There are 3 1/2 billion people on this earth. The present food production is sufficient to feed 1/2 billion people at the level of food consumption we enjoy in the United States.

2. Crowding

   which causes -
   Disease to spread faster.
   Mental illness - more stress is placed on people
   Crime rate increase

3. Resource Demands Increase

   More food, water, minerals will be needed

4. Pollution Increase

   More people cause more air, water, solid waste and noise pollution.

5. Larger uses of energy

6. Education

   Larger and more crowded classrooms

7. Recreation

   Less room for parks and camp grounds

8. Freedom Limitations

   Laws prohibit what can be dumped into water, put into the air, etc., so as not to infringe on the rights of others.

9. Increase in industry for a greater economic development

   Economic development must be 3-4 times greater than the population growth.

DITTO NUMBER 7 HAS BEEN REMOVED PRIOR TO BEING SUBMITTED TO EDRS DUE TO COPYRIGHT RESTRICTIONS

QUIZ #1

True or False

______ 1. Eastern Washington is more populated than Western Washington.

______ 2. Immigration had little to do with the increase in population in Washington State.

______ 3. According to the graph on Nonrenewable Resources, gold will run out before you are 30 years old.

______ 4. The population growth in Washington State is static.

______ 5. Washington's population is now growing at its fastest rate.

6. According to Lesson 1, how many children may you have in order to obtain zero-population growth. ________

7.-10. What are 4 possible causes or results of increasing population?

7. ____

8. ____

9. ____

10. ____

LESSON 4

CONCEPT: The need for more food has encouraged the use of more pesticides for agricultural production.

MATERIALS: Dittoes #8, Reports 1, 2 and 3
Quiz #2
Film: Of Broccoli and Pelicans and Celery and Seals, 30 min., color

TIME: 1-1 1/2, 50 minute periods with quiz. May require 2 periods if film is shown and depending on discussion.

PROCEDURE: Each report presents a different perspective on the control of pests. Some of the information illustrates man's tragic incompetence in using these chemical tools. Others show pathways that offer, perhaps, more fruitful lines for investigation.

Each student should become familiar with the major ideas of each of these reports. It will be up to you to design the most effective method of using the information.

These are several possibilities:
(1) Divide the class into 3 groups. Each group could be responsible for a type of panel presentation. The panel could include outside research.
(2) Teacher-directed discussion. Each student reads all the reports.
(3) The topic of each report could be discussed in general then each student could select a topic to do extra research on. Help students keep in mind that the problem is what is best for the total environment, not the negative aspects of toxic pesticides. After the reports are discussed the film may be shown.

EVALUATIVE ACTIVITY: Quiz #2 (10 min.)

SUGGESTED EXTRA ACTIVITIES:

1. Talk to experienced gardeners and nursery men and find out what the chief plant pest problems are in home gardens in your community.
2. Then find out how such problems can be controlled using the very minimum of pesticides, and if pesticides must be used, using those that are the least harmful to the environment.
3. Make up a mimeographed sheet with the least damaging solutions to the typical pest problems of your community's gardeners. Give the sheets to nurseries in your area.

Answers to Quiz #2
1. pesticides
2. Using one pesticide can kill other insects or animals possibly ones that prey upon more harmful insects than those we set out to kill.
3. pelican

QUIZ #2

1. Chemical poisons used in the war against insects are called ______________.

2. What is the main problem with using a pesticide to kill one insect?

3. Plants ⟶ fish ⟶ seals

   Plants ⟶ phytoplankton ⟶ fish ⟶ pelicans

   If DDT passed along these food chains which animal would contain the greatest amount of DDT (1) seal or (2) pelican.

CONTROLLING PESTS

Ever since man farmed large areas of the earth's surface his chief competitors for the crops have been insects. His crops are attached by hordes of insect pests. In the field or in the woods an insect has to compete with many different organisms for food and space. It has natural enemies, too. Therefore, its numbers are kept in check. Farming destroys many organisms and their homes and food supplies. Often the few kinds of insects that remain develop large populations.

Three reports describing a variety of different pest problems follow.

REPORT 1 - UNEXPECTED RESULTS

The weapons used most often in the war against insects are chemical poisons. They are called pesticides. Man has covered thousands of square miles with pesticides to try and protect his crops.

The pesticides are usually sprayed over an area to control a certain insect. But what do they do to the rest of the environment? It is impossible to predict all of the effects of spraying. Here are some recent examples of unexpected results.

A. The Bollworm in North Africa
The North African cotton fields were sprayed with DDT to control several kinds of insects which feed on the leaves of cotton plants. The early treatment was successful. The growers thus decided to increase the amount of pesticides sprayed on their cotton fields. Then something unexpected happened. Another, more destructive insect pest in the cotton fields, the bollworm, multiplied. Apparently the spray was killing the enemies of the bollworm. The unsprayed cotton was not damaged as much as the sprayed one. Some of the leaf eating insects had been eliminated. But the bollworms destroyed more cotton than leaf-eating insects ever had.

B. The Fire Ant in Louisiana
The fire ant was a nuisance, but not an important crop pest. The state decided to kill off the fire ants with the pesticide heptachlor. The heptachlor spray also killed off insects that were enemies of the sugar cane borer. The sugar cane borer multiplied out of control. The damage to sugar cane crops was so great that farmers sued the state for careless use of poison sprays.

C. The Goldenrod on Roadsides
Plant pest (weeds) have also been sprayed. The goldenrod was sprayed along roadsides. The spray also killed desirable plants.

D. The Spruce Budworm in Oregon
The western national forest are an important source of lumber. Several kinds of evergreen trees in these forests are preyed upon by a spruce budworm. The budworm tunnels into needles and buds on the ends of branches. Millions of acres of trees have been damaged. To control the spruce budworm one year, the United States Forest Service planes sprayed 885,000 acres of forest lands with DDT. Most of the budworms were destroyed. The next summer few budworms were found but the trees were dropping their needles. Several trees were turning brown. What happened?

   1. The red spider mite, which also preyed on evergreens, was not killed by DDT.
   2. Animals such as the ladybug, which prey on spider mites, were killed.
   3. Spraying irritated the spider mite colonies. This caused them to scatter.
   4. Finally because the spider mites had no enemies to control them, great damage was done to the trees.

REPORT 2 - POISONS TURN UP EVERYWHERE

DDT has been helpful in reducing several diseases carried by insects. It has helped control 38 serious diseases. It has saved an estimated 25 million lives.

The use of DDT has helped increase food production. During 1960's man used DDT to control over 100 kinds of insects that feed on crops and livestock.

If DDT has done such good work why has it been forbidden in so many places? Because it is now known that DDT and similar pesticides poison many other kinds of animals, including man. These chemicals are especially dangerous because they are spread throughout the environment by wind or running water. They stay actively poisonous for many years. It is estimated that over 1 billion pounds of these chemicals are now in the earth's water, air, and soil.

A. Poisons in Atlantic Seals
How can hard pesticides poison animals that haven't been sprayed on them? How can DDT spread across the world?

Seals live in the ocean where no DDT has been sprayed. Seals are fish eaters. These fish, in turn, eat smaller organisms in the ocean. High concentrations of DDT were found in the flesh of the seals. Where do you think these poisons came from? Recall how water gets into oceans. Can you see how the DDT passes from the crops to the ocean?

B. Poison in Connecticut Ospreys
In 1954 there were about 150 pairs of ospreys (birds) living and breeding in the valley of the Connecticut River.

In 1964, there were less than 15 pairs. Few of these birds now produce young. Biologists believe that DDT can prevent female birds from laying eggs. They know it causes some birds to lay eggs with thin shells. Then the eggs don't hatch.

Where does the DDT come from? It is not sprayed on the birds. It comes from the food they eat. A plant takes in the chemicals from its environment. When an animal eats many of these plants be collects DDT from all of them. The DDT is stored in the animal's fat. Large animals like the seal or osprey eat these smaller animals and collect alot of poisons in its body.

C. Poison in the Clear Lake Grebes
Near San Francisco there were 1,000 pairs of grebes living around Clear Lake. Grebes are fish-eating ducks. They build floating nests on the edges of lakes. In the winter of 1954 the grebes of Clear Lake began to die. More than 100 were found dead. By 1969, only about 30 pair were left. They made nests, but no young grebes had been found since that time.

An investigation showed that swarms of gnats had been bothering the tourists. People decided to spray the gnats with DDD.

Did the DDD have anything to do with the death of the grebes?

D. Poisons in Man
Because it does such a good job DDT is still used in many placed around the world. Data showing how much DDT is contained in the body is shown below.

Country	Amount of DDT in the Body (parts per million)
U.S. (average)	11.0
Alaska (Eskimo)	2.8
England	2.2
West Germany	2.3
France	5.2
Canada	5.3
Hungary	12.4
Israel	19.2
India	12.8-31.0

Do you think your body contains DDT? Even people isolated from modern civilization contain some DDT. Do you use hard pesticides in your everyday life? Look at the cans of insect and weed killers in your home or in stores. What chemicals do they contain? Are DDD, DDT, DDE, aldrin, endrin, methachlor, lindand, chlordane, dieldrin, heptachlor, or epoxide listed on the label? Can these chemicals harm man? Many of them are known to be very poisonous in large amounts. Nearly all of the foods we eat contain very small amounts of pesticides. No one knows for sure if damage can result from taking in small amounts for a long time. Should we allow these poisons to increase in our bodies while we wait to find out.

Should we try to stop the spread of poisonous chemicals in the environment?

REPORT 3 - MANS ADAPTIONS TO THE PEST PROBLEM
OUTWITTING PESTS

Some scientists are trying to control insect pests without harming other living things. They have used 2 methods. They either try to trick the pests, or use organisms that prey on the pests.

A. Imitating Natural Perfumes

In some kinds of insects, the male finds the female during the mating season by following the smell of a chemical she releases. Scientists, knowing this fact, have made chemicals that work in the same way.

One way is to use a perfume combined with a poison. They the male flies can be killed off and the population wiped out. Also, when the poison-perfume combination is put on fiberboard, it attracts only target insects. Other animals are less likely to eat it. That way the poison would not get spread over the land. This technique was tried out in 1960 on islands near Japan. One year later, over 99% of the fruit fly population had been destroyed.

B. Introducing Sterile Males

A huge number of pests were exposed to radiation treatment which makes them sterile or unable to produce offspring. Swarms of these males are then taken to the place where the pest is doing damage. Because the males are sterile the eggs do not develop.

C. Pesticides from Bacteria

Some bacteria produce poisonous substances. One kind produces a poison that kills the caterpillars of the flour moth, cabbage butterfly, the root borer of bananas, and other insects. The poison is spread over plants. When the caterpillars eat off the poison plants they die. The bacterial poison <u>only</u> kills <u>certain</u> insects.

D. Spreading Virus Diseases
In California, fields of alfalfa, a hay crop, are now being sprayed with a virus. The virus gives alfalfa caterpillars a fatal disease. This saves the alfalfa and doesn't harm the livestock that feed on the crop.

In Canadian forests, scientists are attempting to control the pine sawfly, a pest of lumber trees in a similar way.

E. Introducing Other Natural Enemies
In 1880 a scale insect threatened to wipe out the citrus trees in California. A small beetle that ate nothing but scale insects was imported. It has kept the scale insects under control. Recently, however, chemical sprays used to control other insects have killed off this desirable beetle. The scale insects are less affected by the sprays. They are again threatening the citrus groves.

SOURCE: Man and His Environment
Houghton Miffin Co., Boston

Educational Research Council of America
Frederick A. Rasmussen
Paul Holobinko
Victor M. Showalter

LESSON 5

CONCEPT: Overpopulation causes an increase in air, water, waste and noise pollution.

MATERIALS: The Litter Fact Book
Information sheets - Air Pollution - Ditto #9
Noise Pollution - Ditto #10
Water Pollution - Ditto #11
Films: Recycling Wastes
Noise is Pollution Too, 15 min., color
Air is for Breathing
Conserving our Environment, Pollution Crisis, 14 min., color
Slides: Man and His Effects on the Environment (Bill Guise, ERAC)
Dittoes: #12, 13, 14, 15, 16

TIME: 1-4 days depending upon use of the films and extra activities.

NOTE TO TEACHER: The purpose of this lesson is to briefly introduce the students to the different kinds of pollution caused by man.

PROCEDURE: Divide the class into 4 groups. One for
Air Pollution
Water Pollution
Waste Pollution
Noise Pollution

Have each group read the material provided on the information sheets (30-45 minutes)

Each group should prepare a presentation to give to the rest of the class so that their material is well covered.

Give the students several options:
(1) Make a puppet show emphasizing the points brought out in the sheets.
(2) Make drawings, posters, etc. to point out facts brought out.
(3) Make up a play drawing out situations that illustrate the problem.
(4) The noise pollution group might tape several noises. If a decimeter is available several sounds can be measured for their intensity.

The main idea is to let the students use their imagination to develop ways of communicating the facts on the information sheets. One or 2 days may be needed for preparation.

All or a few of the films may be shown to back up the facts and aid in the students understanding.

After the students give their reports ask: *What happens to each of these pollution situations when you double the population?* (increase)

EVALUATIVE ACTIVITY:
1. Considering the increase in pollution, write a paragraph on the problems of increased population in relation to pollution and possible solutions.

2. Have the class make up a list of things to do to cut down pollutions.

3. Read and discuss "We Can't Run Away Any Longer", Ditto #10

SUGGESTED EXTRA ACTIVITIES: See Extra dittoes - Each group can do the activities related to the separate kinds of pollution.

Ditto 13 - Air pollution Effects on Nylon
Ditto 14 - A Filter for Cleaning Polluted Water
Ditto 15 - Recycline Wastes (paper and aluminum cans.) Also film: "Recycling Wastes", 12 min., color
Ditto 16 - An Electrical Smoke Trap

DITTO #9

AIR POLLUTION INFORMATION SHEET

Thousands of substances contribute to the atmospheric mess man suffers. They pour out from the 100 million vehicles, from the wastes of 200 million people, from the refineries, factories, and businesses that yearly use billions of kilo-watts of electricity.

Pollutants can exist as solid matter, liquid droplets, or gas. Both the solid and liquid matter are called Particulates.

Size of particulates

NOTE: Bacteria are between 1 and 25 microns in size. Raindrops are between 400 and 5,000 microns in size.

1. Smoke describes both solid and liquid particles under 1 micron in diameter.
2. Fume describes the solid particles under 1 micron in diameter that are formed as vapors from chemical reactions. Many industrial processes including smelting and refining emit or give off these fumes.
3. Dust are solid particles more than 1 micron in size. Dust comes from industry and agriculture.
4. Mist are liquid particles more than 100 microns in size.

How many particulates are there?

1. The urban atmosphere is choked with particulates.
2. Los Angeles has 40 tons of pollutants given off per day from gas powered vehicles.
3. An average winter day in New York produces 335 tons of particulate matter.
4. In most heavily polluted parts of cities, from 50 to more than 100 tons of particulates fall each month per square mile.
5. The major industrial contributions to air pollution in the United States are:
   a. Pulp and paper mills
   b. Iron and steel mills
   c. Petroleum Refineries
   d. Smelters
   e. Inorganic chemical manufacturers such as fertilizer manufacturers
   f. Organic chemical manufacturers such as synthetic rubber
6. In 1940, the emissions of organic gases from motor vehicles amounted to less than 600 tons per day while by 1960 it had increased to 1850 tons per day.
7. The motor vehicle engines in operation today discharge pollution from 3 points:
   a. gasoline evaporates easily pouring out hydrocarbons
   b. the gasoline engine is imperfect and a large amount of unburned and partially burned hydrocarbons come out of the tailpipe
   c. carbon monoxide, fuel impurities, and fuel additives discharge from the tailpipe.
8. Each year motor vehicles discharge to the atmosphere of the United States
   a. 66 million tons of carbon monoxide
   b. 1 million tons of sulfur oxides
   c. 6 million tons of nitrogen oxides
   d. 12 million tons of hydrocarbons
   e. 1 million tons of particulate matter
9. Power plants discharge annually
   a. 1 million tons of carbon monoxide
   b. 12 million tons of sulfur dioxide
   c. 3 million tons of nitrogen oxides
   d. 1 million tons of hydrocarbons
   e. 3 million tons of particulate matter

10. Heating our homes each year produces
    a. 2 million tons of carbon monoxide
    b. 3 million tons of sulfur dioxides
    c. 1 million tons of nitrogen oxides
    d. 1 million tons of hydrocarbons
    e. 1 million tons of particulate matter

The Health Effects of Pollution

1. Three tragedies caused by thermal inversions.

Meuse River Valley, Belgium

The first of the tragedies to arouse worldwide concern occureed in Belgium, in the Meuse River valley, where a heavily industrialized area extends for 15 miles. All of Belgium was covered by a thick, cold fog in the first week of December, 1930. This thick fog kept all of the pollutants given off by the industries, trapped near the ground. The pollutants gathered day after day and stayed. Within a few days thousands of people fell ill, 60 persons died from the poisoned air.

Donora, Pennsylvania

The town is also located in a river valley and crammed with industry. In October 1948, Donora also had a cold fog which trapped the pollutants emerging from the factories. The population was 14,000. Six thousand became ill. Twenty deaths were recorded. Sore throats, chest constriction, headaches, breathlessness, burning and tearing eyes, running nose, vomit, and nausea were the common complaints.

London, England

The fogs of London are notorious. So is the pollution. For centuries Londoners heated their homes with soft coal in open fireplaces. The resultant smoke and fog - the old original smog. Again pollutants were trapped and 4,000 deaths occurred.

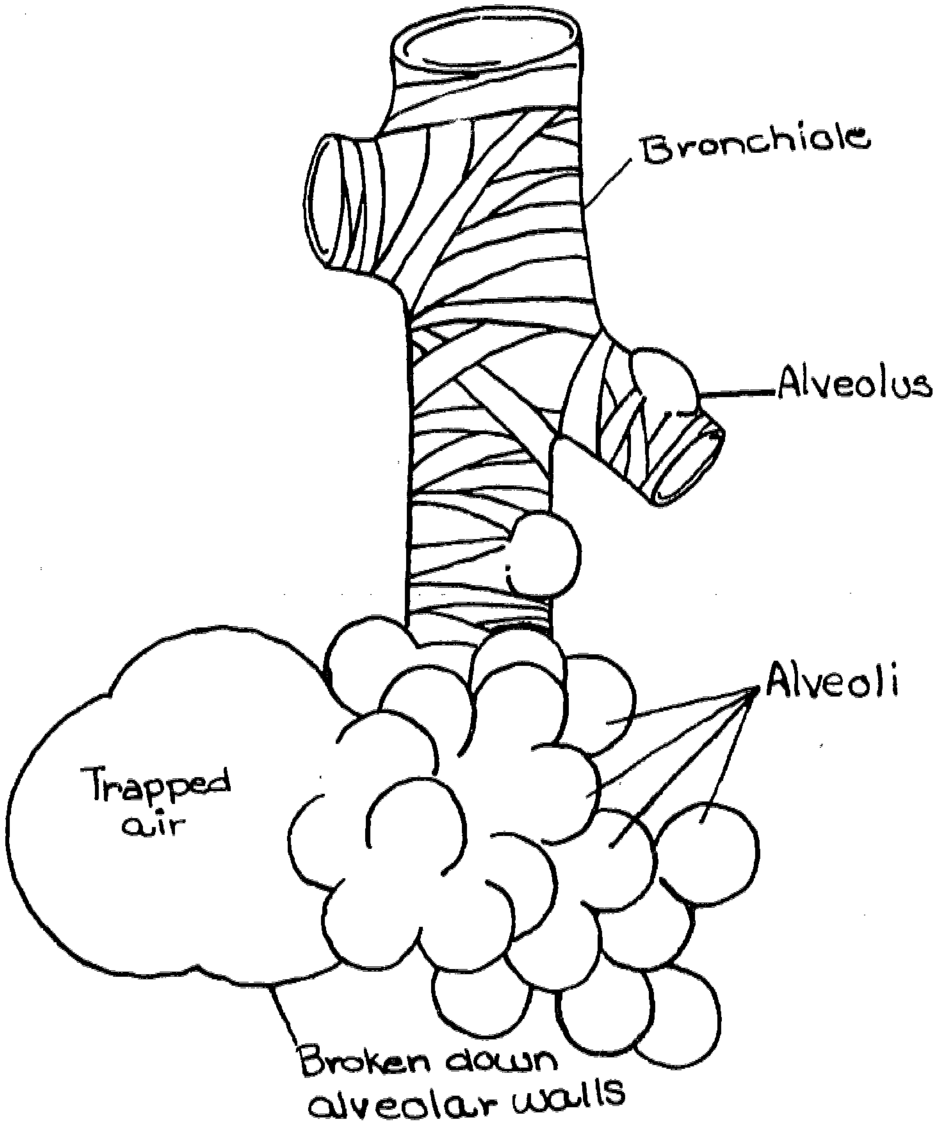
New York

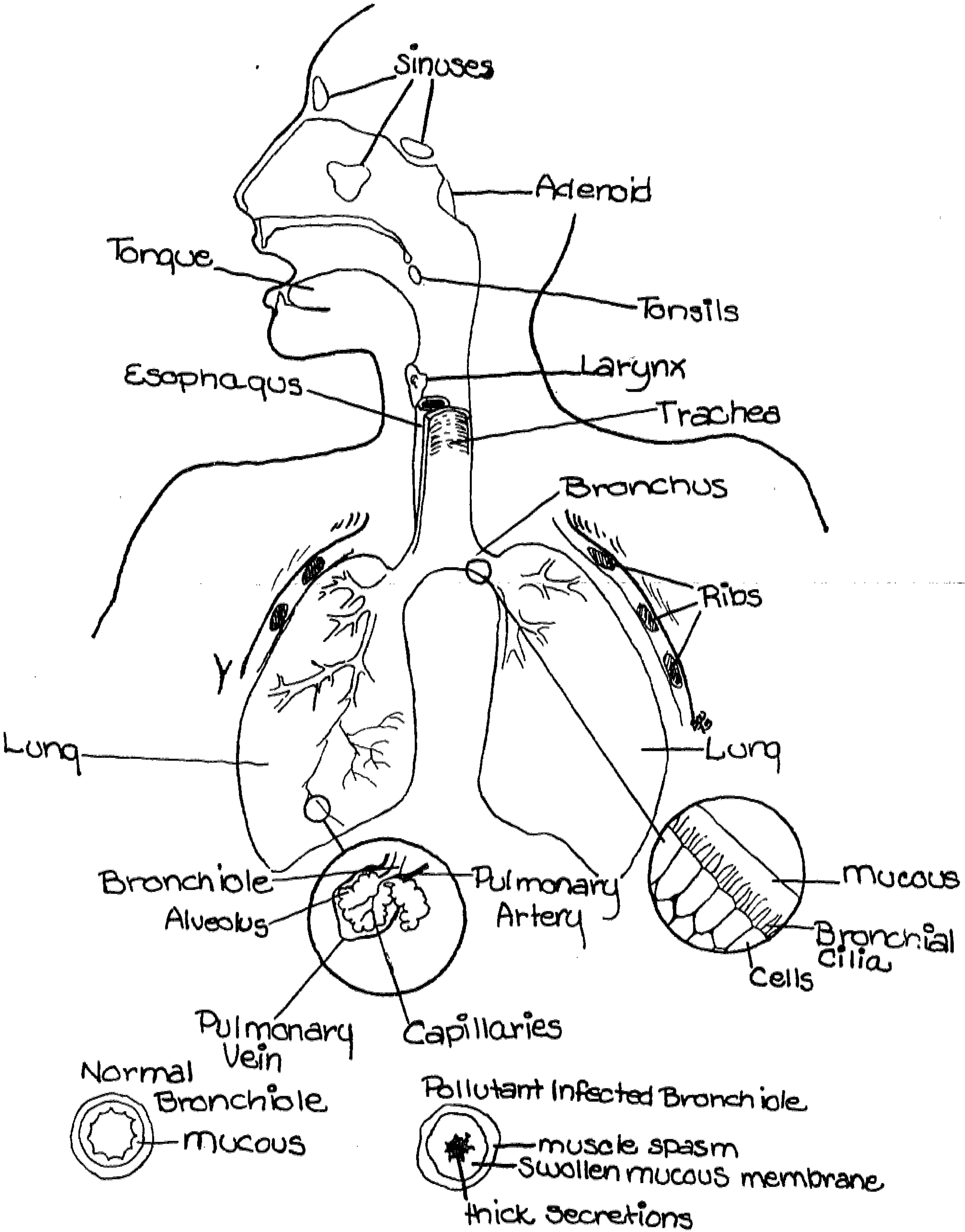
Air pollution episodes took place here in 1953, 1962, 1963 and 1966. In 1963 Asian flue, and extreme cold, 405 people died because of air pollution alone. In 1966 168 people died from air pollution.

How air pollution may affect the respiratory tract

The many studies suggest these conclusions:

1. Certain irritants, either gaseous or particulate, can slow down and even stop the action of the cilia and thus leave the underlying cells without protection. (The cilia are hair-like cells that line the airways. By their sweeping movement they help propell the mucus and the germs and dirt caught in it out of the respiratory tract.)
2. Pollutants can increase the mucus in the lungs.
3. Pollutants can cause the airways to get smaller.
4. Pollutants can paralyze the cells that destroy bacteria in the respiratory system.
5. Pollutants can cause swelling or rapid growth of the cells that form the lining of the airways.
6. Pollutants can cause the cilia to die and even some of the cells to die.
7. The above problems enable bacteria to enter the lungs more easily and cause infection to occur.
8. Emphysema may occur - air goes in the alveoli but is trapped and cannot be exhaled.


Bronchiole
Alveolus
Alveoli
Trapped air
Broken down alveolar walls


Sinuses
Adenoid
Tonque
Tonsils
Larynx
Esophaqus
Trachea
Bronchus
Ribs
Lunq
Lunq
Bronchiole
Alveolus
Pulmonary Artery
Mucous
Bronchial Cilia
Cells
Pulmonary Vein
Capillaries
Normal Bronchiole
mucous
Pollutant Infected Bronchiole
muscle spasm
Swollen mucous membrane
thick secretions

DITTO #10

NOISE POLLUTION INFORMATION SHEET

NOISE, A POLLUTANT THAT HURTS MORE THAN EARS

Noise is another dangerous kind of pollution caused by an increase in the number of people and industries found in cities. One great problem in stopping noise pollution is that people can't agree on what it is. A scientist says that a noise is a sound that is not wanted. The question is "Not wanted by whom?" A noise for one person may be a welcome sound to another. For example you might like to hear your own singing. To your friends it may be noise. The sound of a jet engine might be pleasant to the pilot of the plane but deafening to the city below.

The decibel is a measure of sound, just as an inch is a measure of length.

Sound	Decibels
Whisper	40
Talking	70-80
Jet plane (1200 ft. up)	100
2 motorcycles	107
Jackhammer (10 ft. away)	98

Sound can be dangerous to people. Scientists call 80 decibels a loud noise, 100 a deafening noise, and 120 a dangerously loud noise. People who work every day where the noise level is more than about 85 decibels often start to lose their hearing. Even noises that aren't that loud can be harmful. Constant noise can keep people awake at night and keep them from relaxing during the day. People who live near airports, busy highways, or firehouses often suffer very much because of the noise around them.

Scientists think that the whole world may be getting noisier at the rate of about 1 decibel a year. Most of that increase is in the cities. Already parts of the cities are unpleasant because of noise. Soon they may be dangerous too.

The Terrible Dangers In City Streets

As scientists examined the ruins of the old Iraqi cities they found that sewers ran only to the houses of the rich people. No one really knows what the poor people used for toilets and garbage cans. Probably, they threw everything into the streets or into shallow ditches that ran through the city.

That is what poor people in most cities had to do until about 100 years ago. (In some parts of the world this is still done.)

Probably the people of old Uruk did not like the way their city smelled and looked. Many people in modern cities complain about the same things today. But what the people in Uruk did not know was that the filth around them was causing sickness and death.

The link between filth and disease was not discovered until about 1850. At that time certain English doctors began to notice that the dirtiest parts of London had the most disease. There are many reasons why poor people get sick more often than rich people. But the English doctors blamed the sickness on bad smells and gases that rose from rotting sewage and garbage. The doctors had to fight very hard to get London cleaned up. No one in the city wanted to spend money on sewers or on street cleaning. Finally laws were passed, London became cleaner, and certain diseases became less common. The doctors had done the right thing but for the wrong reasons.

Today scientists know that is is bacteria and viruses in the sewage and garbage that cause certain diseases.

Sickness Pumped From a Well

In a city, many people get their water from the same place. As a result, if anything dangerous gets into the water many people may get sick. That is another example of how crowds of people can cause problems. In some cities water was piped from the nearest river. No chemicals were put into the water to kill germs. No one cared that the water had garbage and human wastes floating in it. Many neighborhoods in the old cities didn't have piped water at all. Instead there was one well where people came to get water. Very often filth drained out of toilets and off the streets into these wells causing disease.

In 1853 a disease called cholera swept through the city of London. Later it was found that a toilet had been draining into the well and the man who had been using the toilet had cholera. In this way one person's sickness was spread to many people.

Today many people still get their drinking water out of the same rivers where they dump their sewage. However, the water is cleaned and carefully treated with chemicals to kill any bacteria that might cause disease. Often city water is so polluted that a lot of chemicals must be added. Some people have called today's drinking water a soup made of dead bacteria, flavored with chemicals. Some city water tastes about that bad.

Pollution of Rivers by City Sewage

After wastes have been in a river for a while, they start to rot. The rotting uses up much of the oxygen in the water. Fish and other river animals that need oxygen to live either die or move away. Today some rivers have so many cities along their banks that the fish have few places left to move.

Sewage from cities also contains many kinds of chemicals and even oil. Factories dump dangerous chemicals into rivers. These chemicals can be strong enough to kill living things in the water. Detergents also add to the water pollution problem. These detergents act like fertilizer when they get into the water causing tiny green plants called algae to grow. The algae use up oxygen in the water not only when they are alive, but also after they start to die and rot.

SOURCE: Ecology: The City
by George McCue
Ben Ziger, Inc., 1971

WE CAN'T RUN AWAY ANY LONGER

Until recently man did not have much influence on the biosphere. When he was a hunter, he killed the animals and gathered the plants he needed for food and clothing. He used stone for tools and clay for pots. His few activities exterminated no animal or plant species and polluted few streams and his campfires did not seriously pollute the air. He used such small amounts of the natural resources that even if he had not existed, it would have made no noticeable difference.

When man became more numerous and civilized he did begin to make a difference. This was especially true in Europe. He destroyed the forests in some areas. His domesticated animals overgrazed grasslands which they became unproductive wasteland. He had so many children that the land could not support the ever increasing population. His wastes began to pollute the streams and air. All of this meant that the local environment could not tolerate his activities - he was destroying natural resources faster than nature could replace them.

But there was always a solution - move. And so he did. Many people found new homes in Africa, North America, South America and Australia. For several centuries these new lands could supply their needs and cope with their wastes. Nature seemed soooo big, and for a while man's demands on the whole biosphere were not so great.

Things are very different now. There are no new continents to be discovered. Nearly all the land that can be used to grow man's food is being used. We can't run any longer to a place where there is an abundance of fertile land, clean air, plenty of natural resources and unpolluted streams. For the first time in history, man must face this choice: Either he learns to live with nature, or he cannot live at all. He can no longer live by destroying nature and then moving on.

Your parents now face this choice, and in the years to come you will have to face it. More water is needed in homes and in industry--yet we are polluting the water we have. We enjoy the convenience of the automobile--but its exhausts are making the air in many of our cities harmful to health. We need more food--yet some of our agricultural practices actually destroy the ability of the land to produce.

The environmental crisis is the result of several hundred years of neglect. The problems cannot be cured overnight. Though the situation is serious, it is certainly not hopeless. More and more, industries and government are making efforts to cooperate in improving environmental conditions. Lead is being removed from gasoline. Automobile manufacturers are spending large sums of money to design engines that will not cause pollution. We may see steam- or electric-powered cars in production within a few years. Cleaner, faster systems of public transportation in and between cities are being designed. There is widespread concern about the extinction of wildlife species. Chemicals such as phosphates in detergents, long-lasting pesticides, compounds containing mercury, and many other polluting substances are being banned. New methods of reclaiming water from sewage are being designed. The importance of photosynthesis--the key to life--is being recognized by more and more people. Many factories are being equipped with filters and other smoke-control devices. The use of "clean-burning" fuels is increasing. New methods and better locations for disposal of solid wastes are being sought out.

You might wonder, What can one person do to keep the world livable? Perhaps the first thing to do is change the question to, What must I do? There is quite a lot.

All of us, both individuals and groups, have to change our lives so that we live in balance with the biosphere. We have to insist that industries not be allowed to dump their wastes into streams and lakes--killing the fish and making the wa ter unsuitable for drinking. We must insist that means be taken to reduce air pollution--from industry and from automobiles. We must save enough of the undisturbed landscape to ensure the survival of wild animals and plants--and to provide outselves with places to observe and enjoy nature.

These and other large, long-range tasks will require support from all parts of our society--government, industry, and -eneral public. You can help by indicating your concern in letters to your local newspapers, business leaders, representatives, senators, mayor, or governor. And, before long, you will be able to vote for those lawmakers who show they care about the environment and are anxious to protect it.

There are also things you can do that will make a difference immediately. Most people are thoughtful, but some are not. You may see litter in the streets, in parks, or even in parts of your school yard. If you and your classmates decided not to litter, and also decided that every day each of you would pick up one piece of paper or an empty bottle and put it in a trash basket, you would soon have a much more pleasant environment.

But more than anything else, you must think. You now know a great deal about the biosphere. You know that it is in delicate balance and must be treated gently. It is up to each of you to see that what you, your community, and your country do will not interfere with that balance. Protect the biosphere--it is the only one you have.

SOURCE: Ecology: The City
by George McCue
Ben Ziger, Inc., 1971

DITTO #13 EFFECT OF AIR POLLUTION ON NYLON

MATERIALS: Nylon stocking
Stiff cardboard, 1 foot by 1 foot
Wood pole 3 feet long (broom stock)
Magnifying glass

PROCEDURE:

INTRODUCTION:
Many cases have been reported in which woman's nylon stockings were ruined by something in the air. The damage occuring while the stockings were being worn. In some instances, large holes were produced in the nylon material.

The cause of this particular kind of air pollution damage has been called "acidic soot". If you'd like to know whether or not acidic soot exists in your neighborhood do this experiment. (This will take about 1 month).

1. Make a hole in the center of the cardboard, 6 x 6 inches.

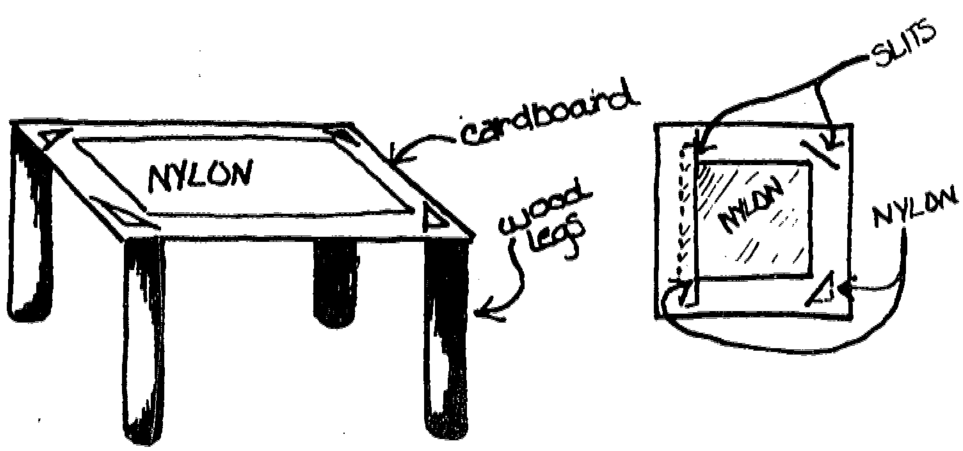
2. Saw the pole into 4 pieces - put these under the 4 corners of the cardboard making a table.

3. Cut out an 8" square piece of nylon.

4. Make a slit into each corner of the cardboard and work the ends of the nylon into these slits.

5. Put the nylon outside where it is not likely to be disturbed.

6. Check the nylon each week for holes.



DITTO #14 A FILTER FOR CLEANING POLLUTED WATER

MATERIALS:
2 quart plastic jar with a lid
2 cups of pebbles
2 cups of coarse sand
2 cups of gravel
2 cups of fine sand
2 feet of wood, 8" wide
nails (4)

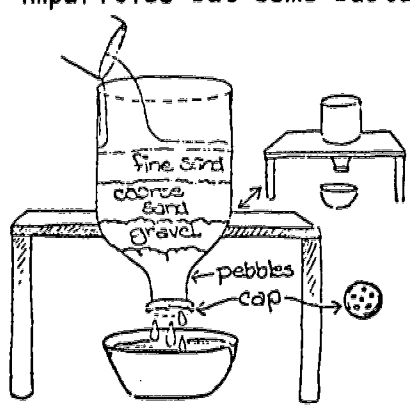
Almost any construction company will supply these free

PROCEDURE:

INTRODUCTION:
Water, how precious a gift. Next to air it is the most important thing in our lives. Without water in any form, a person wouldn't be able to stay alive for more than a week.

The average American uses about 70 gallons of clean water each day in his home. Because of the extent to which water has been polluted, clean water is becoming more difficult to produce. It's easy for a water treatment plant to remove debris suspended impurities and disease germs. But dissolved chemicals and pesticides are something else. Scientists are attempting to develop ways of preventing such pollutants from getting into the water in the first place.

The model water filter featured in this experiment represents part of a basic purification process used by cities to treat their water. This process consists of (1) coagulation and settling (2) filtration (3) disinfection. Filtration removes not only solid impurities but some bacteria, too.



1. <u>Stand</u>: Saw 2 6" pieces off the wood. These will be the legs of the stand.

2. Cut a 4" diameter hole in the remaining piece (in the middle) for the container support.

3. Nail the stand together.

4. Using a sharp instrument slice off the very bottom of the plastic container.

5. Next punch holes in the cap as shown in the figure and put the cap back on.

6. Filter bed
    a. Put pebbles up to the narrow part of the neck
    b. Follow with gravel up to the top of the funnel section
    c. Pour coarse sand in - 2 to 3 inches
    d. Finally add the same amount of fine sand

7. Put a white bowl under the filter

8. Try filtering some water
    a. muddy
    b. dishwater
    c. bathwater

9. Does the water look any cleaner?

DITTO #15

RECYCLING WASTES

MATERIALS: Newspaper
Mixing bowl
Egg beater
Tablespoon of wallpaper paste or laundry starch
Window screen section
Wax paper
Drinking glass

PROCEDURE:

INTRODUCTION:

Paper and paper products make up about 1/2 of the solid waste produced by cities and towns. So the paper industry is getting more and more involved with recycling.

In 1969, the paper industry recycled 58½ million tons of paper waste. Of this total, old newspapers accounted for enough paper to save about 5 million trees from the axe that year.

Incidently $25 million was made by the people who collected the paper.

1. Cut up 12"x12" pieces of paper into small pieces about ½" square.
2. Put these pieces into a mixing bowl and add a cup of water. Let the paper soak for a while.
3. Beat up the paper until it is broken up into oatsize pieces.
4. Pour in the paste or starch (flour may also work)
5. Use the screen to remove excess water. Pour the mixture through the screen and spread it out like a thin pancake.
6. Lay a sheet of waxpaper over the mixture and roll it with the side of the glass.
7. Let the mixture dry (it may take up to 2 days)

The result should look like gray cardboard. You may want to try and make something useful out of the recycled paper - log rolls, chair

AN ELECTRICAL SMOKE TRAP

MATERIALS: Wood base 6" by 6"
Wood support 14" long
Cardboard tube, 1½" in diameter (paper towel roll)
Aluminum foil, 6"x6"
2 toothpicks
6 volt lantern battery
9' of bell or hook-up wire
Knife switch
Type F-7996 induction coil or Model T spark coil

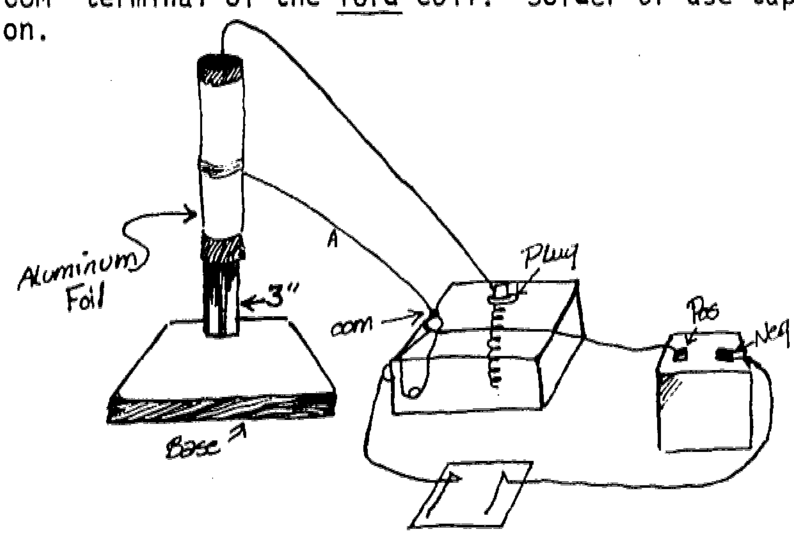
PROCEDURE:

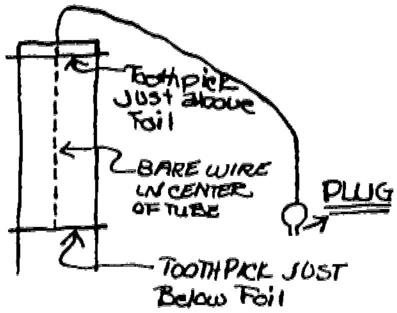
INTRODUCTION:
One way some industrial firms have been fighting air pollution is through the use of electrostatic precipitators. These devices capture smoke, dust, and liquid particles before they have a chance to go up the chimney into the atmosphere.

In general electrostatic precipitators work as follows:
1. On the way to the chimney, smoke and other wastes are channeled past wires and plates that are oppositely charged at high voltage.
2. The particles receive a negative charge from the wires.
3. As a result they are attracted to the positive plates.
4. This action keeps pollution down and also produces useful by products.

Electrical utility companies have been using such devices for decades.

Start by
a. Nail wood support to the base
b. Wrap aluminum foil around the cardboard tube about an inch from the end of the tube. Tape the foil in place.
c. Remove 6 inches of insulation from a 3 foot piece of wire.
d. Wrap the bare portion around the foil ½ way up its length and twist tightly.
e. Mount the tube on the stand. (Leave 3" of clearance between the bottom of the tube and the base.)
f. Take wire marked a in the diagram - take off insulation and attach it to the "COM" terminal of the ford coil. Solder or use tape to hold the wire on.



g. 

From a second 3' piece of wire remove 7" of insulation. Put the bare part down the center of the tube. Use the toothpicks as support bars. Put the toothpicks in just above and just below the foil.

h. After hooking the lower toothpick, pull the wire snugly, and loop it around the upper toothpick. Keep the wire centered within the tube. Connect the free end to the PLUG terminal on the coil.

i. With the remaining wire complete the connections as shown. Leave the knife switch open. CAUTION: When the knife switch is closed, the smoke trap will be "ON". When it is do not touch the terminals on the coil, the wires from the terminal, or the aluminum foil.

j. Let's see if it works!
Hold a source of smoke under the tubing. When you see smoke coming from the top of the chimney close the knife switch. If the tubing stops smoking it works.

NOTE: When the knife switch is closed there should be a buzzing sound. If it doesn't, open the switch and adjust the nut on the vibrator arm.

LESSON 6

CONCEPT: All organisms must adapt to changes in their environment if they are to survive.

MATERIALS: Dittoes 17, 18, 19
Pictures of different races of men

TIME: 2 50 minute periods

PROCEDURE: Ask: *What does adapt mean?* (to change or adjust to a change)

Give the students Ditto #17 and have them try and answer the questions (20-25 minutes)

Discuss the questions. Have the kids bring out as many ideas as possible.

Give the students Ditto #18 to read. Have them answer the questions if time permits or answer at home. The answers should be discussed.

Show films: "The Ice People" (for Geography)
"Ecology" (both geography, science)

EVALUATIVE ACTIVITY: Quiz #3, Ditto #19

SUGGESTED EXTRA ACTIVITY:

1. Collect pictures of different animals, list characteristics and what they might have adapted to.
2. Have the students draw a picture illustrating how man might adapt to all of the changes in his environment
3. Films: "Desert Insects"
"The Winners"
"Search to Survive"

Answers to Ditto 17b:

1. Smaller ears reduce heat loss. The colder the climate the smaller the ears.
2. To tread on snow and ice. Arctic animals need broader, better padded feet than their relatives in warmer climates.
3. Deciduous leaves are broader. Cactus have spines. The broader the leaf the more the water loss and the better the ability to absorb sunlight.

Answers to Ditto 18:

1. peppered
2. white bark with darker moss areas
3. black
4. the trees turned black - were covered with soot
5. peppered
6. black
7. peppered
8. natural selection
9. nature selects for the species which is best adapted to its environment

Answers to Quiz #3

1. The bird's beak shape changed because of the lack of vegetation. Two types of birds evolved.
2. Natural selection

DITTO #17a

Can all organisms adapt to change? What happens to organisms that don't or can't adapt?

Think a minute. Do all rabbits have the same ear size? Do some rabbits have short ears and others have long ears? Most rabbits have the same size ears. Could there have been some rabbits in the past with very short ears?

What happened to the dinosaurs and the giant birds? What happened to the short eared rabbit? Scientists are puzzled about this and still trying to find the answer.

Let's look at a problem. One time long ago some rabbits had short ears and some had long ears. The rabbits have many predators (enemies) and makes a delicious dinner for many animals. The rabbits ears are the only things that he has to warn him of danger.

1. Which ears are better to hear with. Long or short ____________________

2. Which rabbits can hear better. Those with long or those with short ears? __________

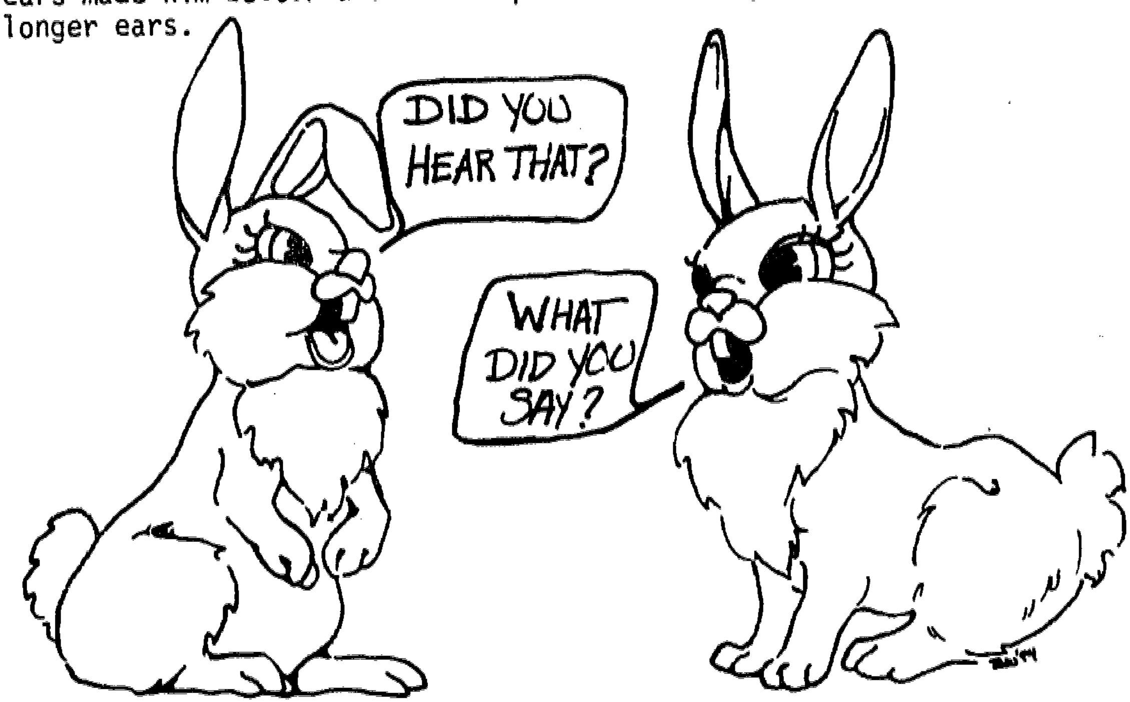
3. Which rabbits would be more likely to escape a predator? ______________

Soon since so many short eared rabbits were caught there became a fewer number of them. Many of them never grew old enough to have baby rabbits, with short ears.

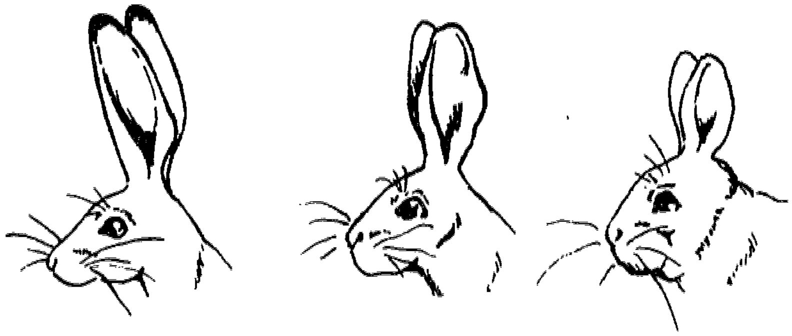
4. Which rabbits increased in number? ___________

5. Which type of rabbit decreased in number? ________________

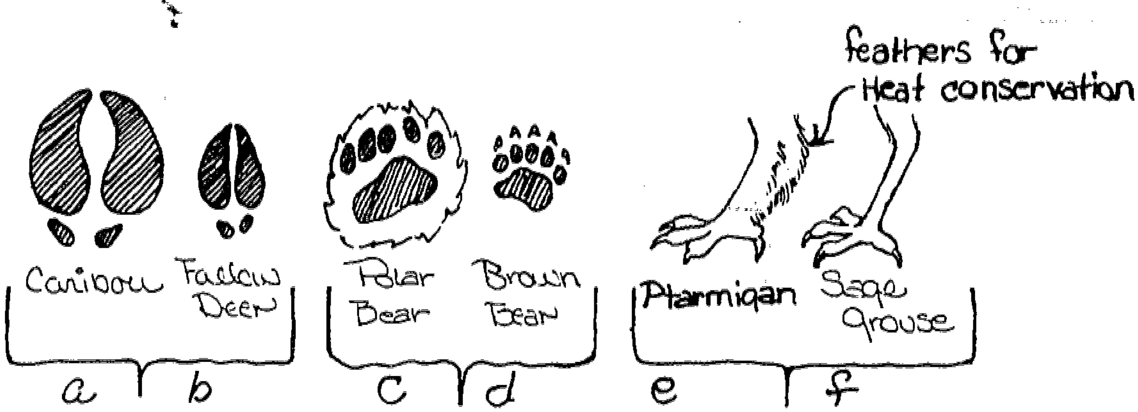
The long eared rabbit was better able to survive in his environment because the length of his ears made him better able to adapt. This is why most of the rabbits you find have longer ears.



RABBITS

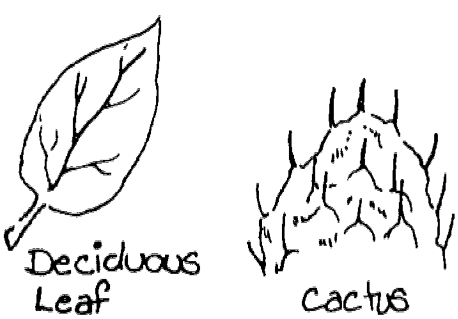


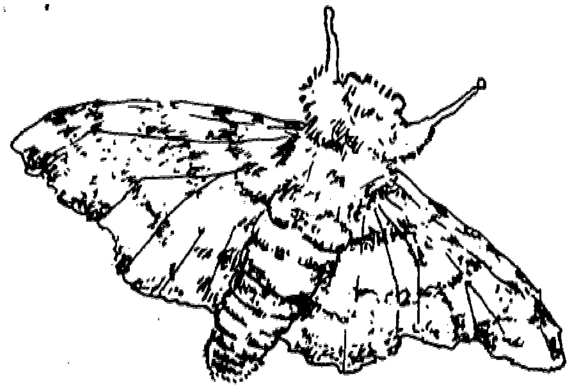
1. Why do the rabbits have different sized ears?



2. Can you see any general difference between the footprints of a and c and b and d?

3. How are the leaves of a deciduous tree and a cactus different? Why?





THE PEPPERED MOTH

The story of the Peppered Moth shows how natural selection caused at least one characteristic of an animal species to change when an environment changed. One hundred years ago, most of the members of this species were white with black, pepper-like spots. Some, however, were dark. Today, most of the members of the species are dark. This is the story of how the change occured.

In England, there are many birch trees. A hundred years ago they had white bark, spotted with patches of darker mosses. When the white peppered moths sat upon the trunks of trees with their wings spread, they were very difficult to see. The members of the species that were dark all over were quite easy to spot.

Several species of birds feed upon moths. You can imagine which variety of the peppered moths they found most easily! Both dark and light moths were eaten, but many more of the dark moths were eaten.

Gradually, in the cities of England, factories were built. These factories burned coal to run their machinery, and from the smokestacks poured tons and tons of soot. The soot settled upon the countryside, causing the bark of the birch trees to look black instead of white.

In areas where there were factories, the dark moths had an advantage over the light moths. With wings spread, the light moths were easily seen by the birds, but the darker ones were difficult to see. So more of the darker ones survived to reproduce. And their offspring, since they inherit the characteristics of their parents, were more likely to be the dark color also. That is why today, in most places in England, there are more dark moths than white ones with peppered spots.

The only places where the light moths still make up the larger part of the population are the places where there are no large factories nearby. Here, the trees are still white, and it is an advantage for the moths to be white with peppered spots.

Questions to Peppered Moth reading

1. What color were the moths 100 years ago before the industrial revolution?

2. What did the trees look like?

3. What color were the moths that were easy for the birds to catch?

4. What happened to the color of the trees as factories were built up in England?

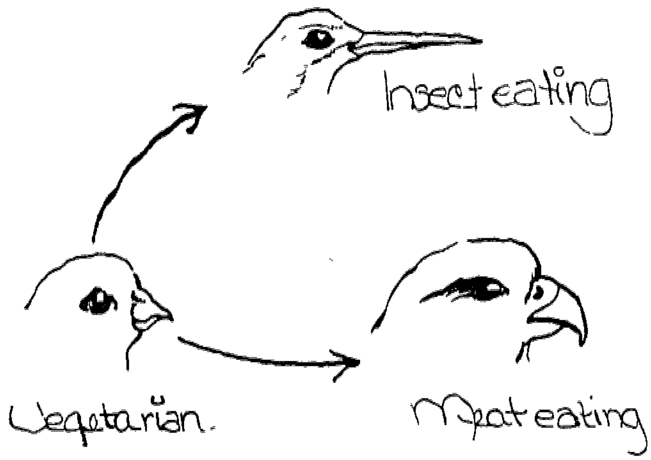
5. Which moths were easily spotted by the birds after the factories were built?

6. Which kind of moths would most likely be found after the factories were built?

7. Which moths would die out? Peppered/Black

8. What is this process called?

9. What does natural selection mean?



Look at the diagram above

The picture illustrates this story. One kind of bird flew to the Galapagos Islands from an area with a lot of vegetation. It found itself in another kind of environment.

(7 pts.) 1. Describe what happened to the bird and in detail how this change or adaptation occurred.

(3 pts.) 2. What is this process called?

LESSON 7

CONCEPT: Man is an organism that must adapt to the changes that are occuring in his environment or attempt to control these changes to improve his environment.

MATERIALS: Ditto #20 and 21
Planet management game
Film: "Future Shock" (Extra)

PROCEDURE: Say: *We have seen how animals have adapted over time to changes in our environment. What changes has man's environment undergone during the past 20 years?* (increase in different kinds of pollution)
What possible adaptions must man make if he is to survive these changes?

1. change lifestyle
2. change in actual physical body

It's going to be up to you to change whether we try to control what we are doing now or we might have to adapt to.

Divide the class in 2 groups.

1. Ask half of the students to develop possible ways that we can act to avoid such extremes. (Examples on Ditto #21) in population change. These can be compiled and dittoed and these students might go on a campaign around the neighborhood distributing these and explaining how they feel. Their experiences should be discussed.

2. The other half of the class might develop a script of the future if we don't control these environmental changes. READ: Ditto #20. The play can be put on at night or on a Saturday. If deas (2) does not appeal all the students might develop control ideas.

EVALUATIVE ACTIVITY: Perform play.
Discuss reactions to discussion with community.

SUGGESTED EXTRA ACTIVITIES:

1. Play planet management game.
2. Interview a 70 or older person. Ask them to describe how they have seen the environment change.
3. Make a model of your home 30 years from now.
4. If you have access to the book Man and the Environment Life Science Investigations - play Planet Management Game - (population)

EVOLUTION IN THE NEXT 100,000 YEARS

'If man continues to exist, he will continue to evolve'

by Harry L. Shapiro

For a society which takes for granted the concept of human evolution and uses "Neanderthal man" as a household word, we have given strangely little thought to mankind's evolution in the future. It is as if we conceived that evolution, having produced Homo sapiens, could go no further and, having dusted off its hands, had called it a day.

Yet there is no reason whatever for assuming that we have a permanent lien on our present "pinnacle of evolution." The forces that brought the primate line named man to his present status have not abdicated their functions. If man continues to exist, he will continue to evolve.

Indeed, it is not inconceivable that man is on the verge of a totally new dynamic in evolution. He is approaching the time when he may be able to take over the function of directing his own evolution. This is a great "if." If, in fact, this comes to pass, and man controls not only his culture but the kind of successors he chooses to have, the possibilities of biological improvement are immense.

Before considering these revolutionary implications, let us project into the future the path of natural selection man has been following. The three major physical characteristics that together distinguish man from all other creatures are the hand, erect posture, and the brain. Among these, progressive changes in the brain have been the most closely linked with his continued evolution.

If our scientific and technological developments continue at an increasing rate--as they have in the past--we can expect that future man's principal adaptation will be in the structure of his brain and the associated neural mechanisms.

At the present moment, it is not possible to indicate the precise changes that might be involved. They might take the form of some increase in the number of neurons (nerve cells) in the brain and hence an increase in size. Entirely new structures might appear, as others (the cortex, for example) have in the past. Several developments might take place simultaneously.

In man's other major distinctive traits, I can see no fundamental change for the immediate future. His hand, throughout virtually his entire past, has remained remarkably stabilized. For any refinements of function he might conceivably find useful in the future, he could invent a mechanical substitute for physical adaptation, as he has already done so frequently--from the first stone tools onward.

Similarly, the adaptation of the human body to the requirements of upright posture, although not perfect, is well blocked-out. It is ture that a number of people suffer from structural defects associated with the strains of maintaining the body erect: slipped discs in the lower back, sacroiliac weakness, and foot troubles, for example.

Some of the sufferers from these structural weaknesses are no doubt reacting to the effects of civilized life, but the fact remains that upright posture is a relatively new bodily orientation and one that places extraordinary strains on various points in the organism.

It is conceivable, therefore, that some improvement in his adaptation to erect posture might characterize future man. Since the fundamental adjustments have already been

achieved, no new structures or radical modifications of old ones may be expected.

From the earliest manlike creatures up to recent man, the face has progressively grown smaller. The cause has mainly been a change in function of the chewing apparatus. As man altered his diet, his teeth have grown small and certain ones, particularly the third molars frequently fail to erupt. Following this, the jaws themselves have become steadily smaller.

The whole lower portion of the face has, in effect, retreated, leaving the nasal and orbital cavities virtually undiminished. This accounts for the increasing prominence of the nose in the course of hominid evolution--like a mesa that grows more visible as the surrounding structure is eroded away. I would expect to find our succe-sors 100,000 years from now with much smaller faces, more prominent noses and with cranial vaults that--relatively, at least--would look more massive.

As civilization and technology advance, the process of natural selection becomes more permissive in certain areas. Physical traits that once were necessary for survival may end up as unimportant and therefore dispensable. Deviations that formerly were eliminated may now be rendered innocuous and tolerable.

The diminution of body hair is an example of an early change of this kind that may well continue into the future. Man is the only primate lacking a dense cover of body hair. Even baldness has become almost normal for middle-aged men, and it not infrequently begins in young males barely out of adolescence.

Early in human history, such inventions as clothing, artificial shelter and the use of fire created an environment where body hair lost any positive survival value it might have had in rigorous climates. Since a heavy crop of head or body hair is no longer essential, mutations leading to an increasing loss of hair may be more readily established in the future.

To cite another example, visual and hearing defects are now neutralized by mechanical devices that allow their users to function without detriment to reproductive survival. Moreover, the specialization of modern life can accommodate such individuals in niches where their defects are no handicap.

Modern medicine and surgery, which are part of our cultural environment, have successfully compensated for a growing variety of genetic deficiencies that not long ago would undoubtedly have eliminated their bearers at an early age. Many people who formerly would not have survived can now live and reproduce their kind.

This changing relationship in the selective balance suggests that future populations will support a far higher proportion of people whose existence will depend completely on artificial aids supplied by their cultures. In this way the dependence of the human species on the culture it has evolved becomes more and more crucial.

The effect of increasing population density and urbanization is a fascinating field of speculation. One would like to know what the pressures of urbanization in the past have done in fostering special types of personality that might flourish under such conditions, and whether the continuing pressures of the future will tend to favor similar ones. A few tentative studies suggest that such trends exist, but the data are far from rigorous.

As the tempo of cultural change increases, there arises the question of whether natural selection alone can keep pace. In the past, it obviously has. But culture is now moving at a vastly accelerated rate. This could mean that man may find himself in disastrous difficulties in attempting to manage the increasingly complex world he has

created unless he took deliberate steps to control, manage, and even accelerate his own biological future.

That such a beginning may come sooner than we expect was recently suggested in an imaginative piece of writing by R. A. McConnell of the University of Pittsburgh. With tongue in cheek, but with serious intent, the author outlines the methods and rationale of a selective breeding plan, now completely feasible, launched by the Russians in order to gain a critical advantage over the West.

Although such an eventuality may seem repugnant to many of us, it is not a new idea. Various suggestions along this line have been put forward by men deeply concerned lest evolution, unaided by human effort, would be unable to solve the problems created by man's propensity to elaborate his cultural environment.

Galton, almost a century ago, conceived a eugenics program as a way of maintaining and extending the intellectual resources of society.

As our knowledge of human genetics advances and as the ability to control or modify the genes responsible for our heredity increases, the means for altering our genetic makeup or even of controlling our evolution will become even more precise and predictable.

The success of artificial insemination already suggested the possibility that a sperm bank be set up where the spermatozoa of the outstanding men of each generation might be stored and drawn upon to increase the number of geniuses.

According to this idea, a relatively few men could father a vastly greater number of superior children than would normally be possible. As a corellary, it may soon be possible to remove the ova of superior women, fertilize them artificially and nurture the product in a foster mother.

The genetic composition of future populations may also be managed through the control of mutation. Although present techniques for doing this are too rudimentary to be of value, developments in genetics offer hope that this will be possible.

Recent advances in other areas of genetics and in biochemistry seem likely to open the door to still more remarkable progress in the control of the chromosome and its genes.

When we reflect on what man, with the much more primitive methods of selective breeding, has been able to achieve in improved strains of domesticated plants and animals, there should be no doubt that he will be able to accomplish much more in the genetic control of future human populations with new techniques now at hand and with those being discovered.

Moreover, if man were to embark on a program of this kind, he could accomplish fundamental changes in far less time than the older methods of breeding would have permitted.

The imagination can easily run riot with the possibilities that open up. Man would be able to reduce immeasurably the burden of defect that all populations bear.

He could easily increase the highly productive and creative margin of existing populations by breeding generally superior strains or highly specialized individuals gifted for specified functions.

He could select for personality, intellectual and physical traits, or combinations of all three.

He could revolutionize mankind as he has his control over nature.

* * * * * * * * * *

If one were to sample opinion on such matters now, I would expect an overwhelmingly negative response. We have, however, seen in the past profound changes in the attitude of people toward their "inviolable" rights.

One has only to realize that deeply seated social values are susceptible to unsuspected modification.

It is not outside the realm of probability that our ideas about the control of population itself may undergo radical changes.

DITTO #21

YOU CAN DO SOMETHING: LET'S GET TOGETHER!

HOME

Be aware of potentially harmful additives and avoid buying foods that contain such compounds.
Containers: Avoid aerosol cans. They are difficult to dispose of and impossible to recycle because they usually explode if burned or punctured.
Reuse your jars for canning and preserving.
Return wire coat hangers to cleaners.

CHEMICALS

Baking soda and washing soda can be used for many household cleaning jobs and are just as efficient as powerful over-packaged household cleansers.

TEACHING YOUR CHILDREN

Don't drive your children everywhere - let them walk or ride a bike. It's better for them and for the air.
Buy a Christmas tree next year that can be planted outside.

YOUR GARDEN

Don't buy fertilizers made from whale products. Whales are endangered species.

CONTROLLING PESTS

For rodent pests, set traps or keep a cat.
Set out stale beer in a bowl at night to attract and kill snails and slugs.
Kill weeds by pouring boiling water over them.

TRANSPORTATION

To conserve gas and decrease exhaust emissions drive smoothly without unnecessary accelleration. Don't rev up the car.

GET INVOLVED

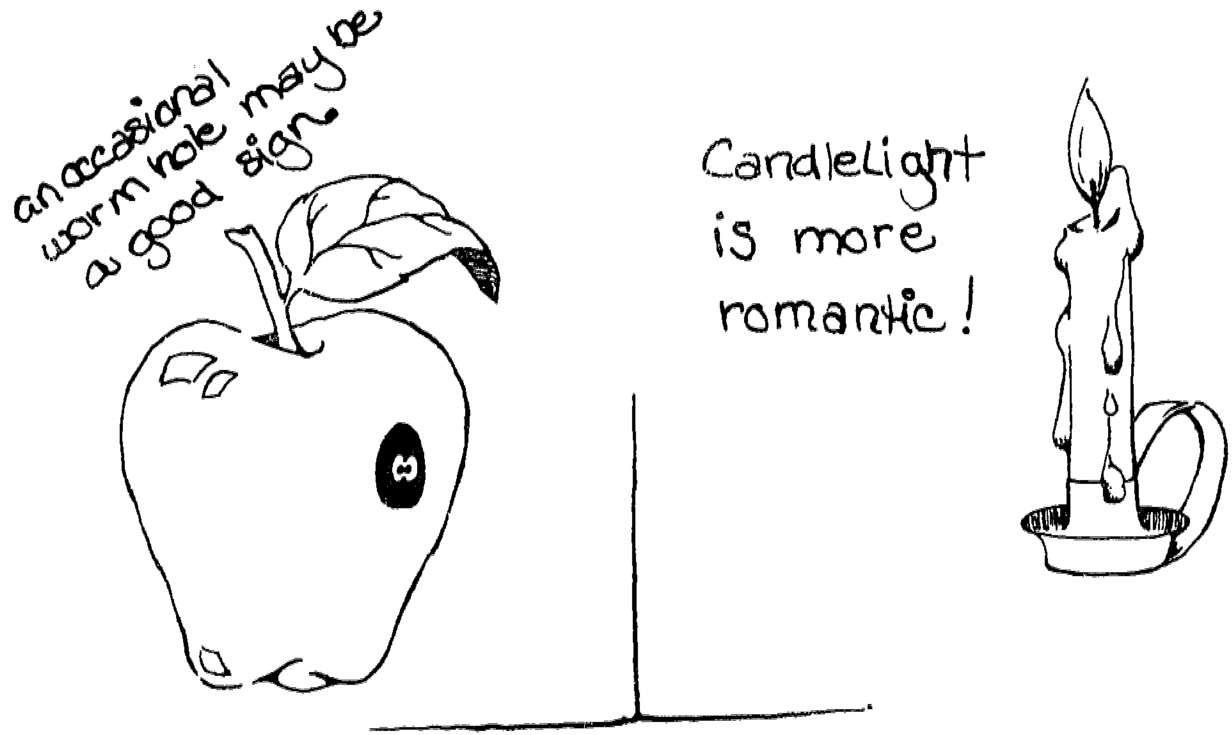
If you see a company using excess lighting talk to them about it.

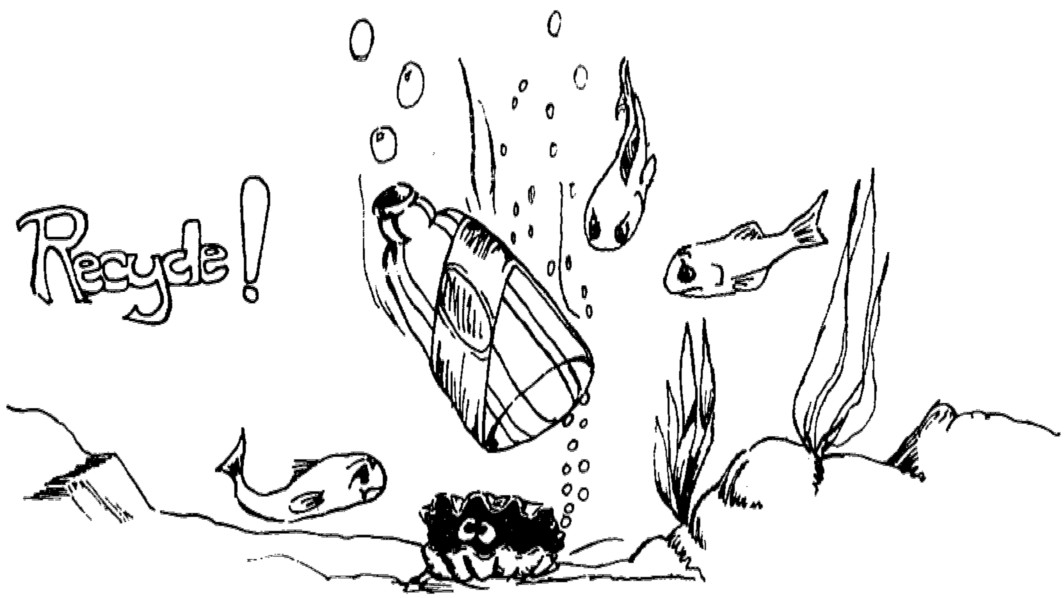
NOISE

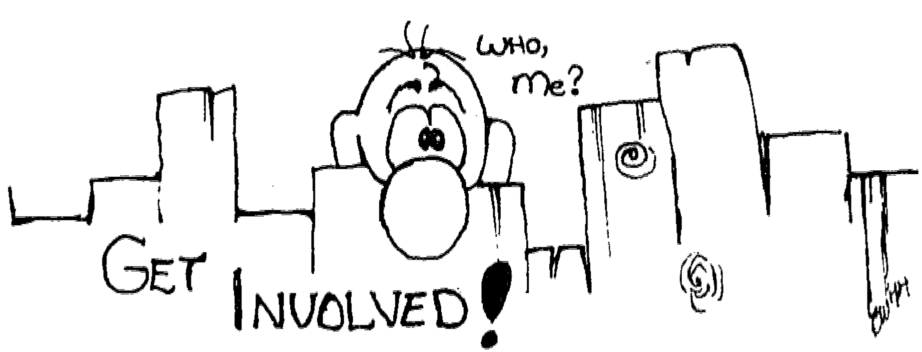
Report excessively noisy motorcycles, minibikes, and cars to the local police.

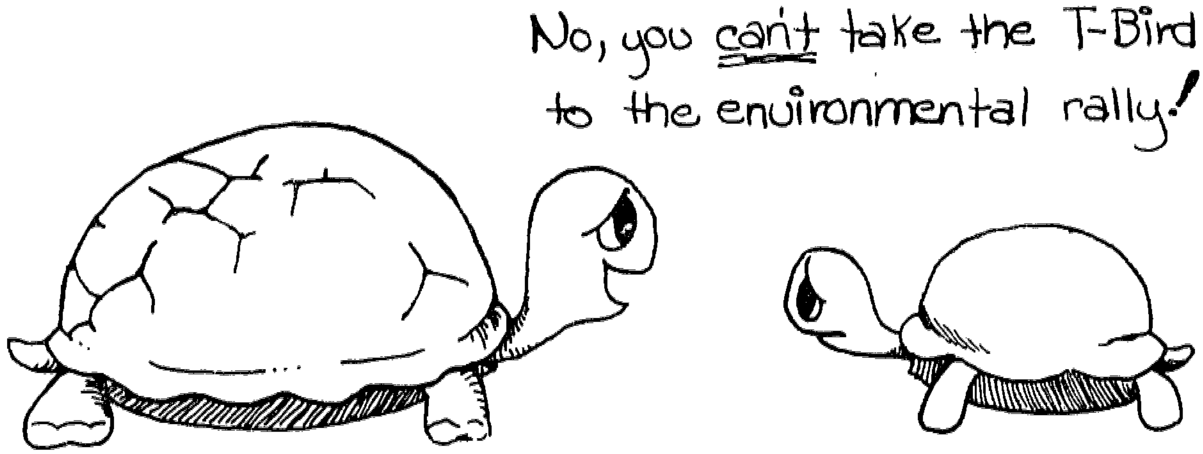
GARBAGE

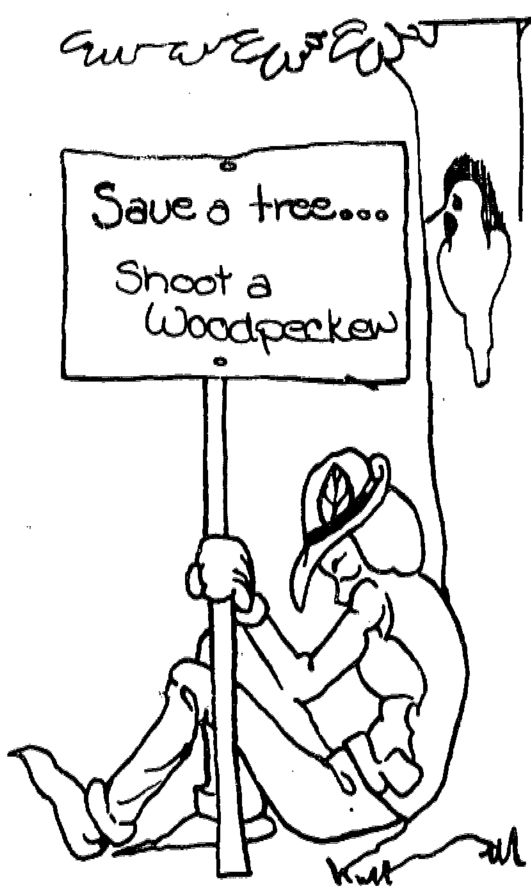
Don't throw out kitchen scraps - they make good compost for your garden.

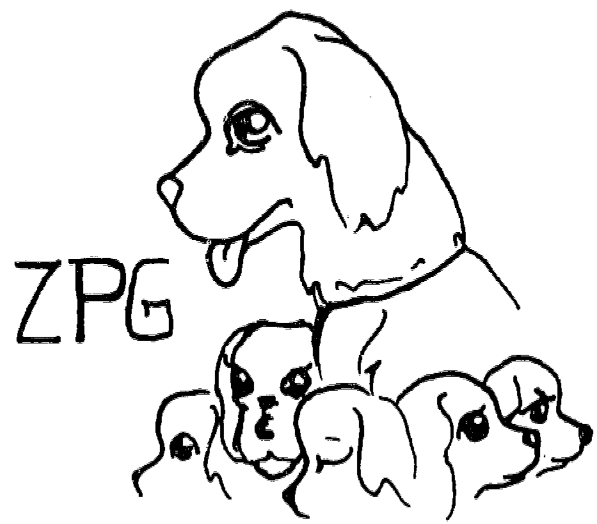

an occasional worm hole may be a good sign.
Candlelight is more romantic!


Recycle!


WHO, me?
GET INVOLVED!


No, you can't take the T-Bird
to the environmental rally!


Save a tree...
Shoot a
Woodpecker


ZPG